



Technology expert Dr Geoff Archenhold reviews the technological innovations of 2015 – a year of industry restructure and where LED overtook traditional volume manufacturing.

2015 TURNS UP THE VOLUME

Last year saw the beginning of the lighting industry restructure with announcements from Samsung and Philips. This year was more of the same with OSRAM announcing it will spin-off its US\$2.5bn general lighting business, including LED lamps and GE moving its lighting business into Current - a new energy focussed business.

One could be forgiven to think that 2015 has been quite uneventful with yet more of the me-too LED lighting fixtures launched by a raft of well-known, start-up and huge but unheard of Asian lighting players. However, there has been seismic shifts within the lighting industry that will have ramifications for the lighting industry over the next few years and beyond.

Several of the key points from 2015 include:

- The loss of one of the great LED pioneers;
- The expansion of the general lighting industry restructure;
- The rise of the Chinese superpower lighting industry;
- The last remaining lighting applications fall to LED technology;
- LED lighting becomes the most popular light source by volume.

DR. ROLAND HAITZ

One of the few pioneers of the solid-state lighting revolution and an engine of innovation that inspired a generation of scientists and engineers to create the LED industry, Dr. Roland Haitz sadly passed away at the age of 80. Dr Haitz's career in science, opto-electronics and solid-state lighting spanned more than 50 years, most of it while associated with Hewlett-Packard and its offspring companies, Agilent, Avago, and Lumileds.

Although a large proportion of people in the general lighting industry may not know of Dr Haitz, those of us who have been in LED lighting for many years regard him as the catalyst for changing the lighting industry forever through both scientific excellence and political persuasion. His predictions



Dr Roland Haitz, who died earlier this year.

through Haitz's Law - the metric he formulated - and his personal efforts in securing national funding in the US for developing a then-nascent LED technology, helped to usher in the solid-state lighting revolution in less than a decade.

Haitz's Law was a fundamental stepping stone for the industry and I have constantly referred to it since my very first article for *mondo*arc* in 2005, initially as a way of persuading a very sceptical lighting industry that LEDs were its future as well as persuading the UK government it should devote resources to this technology. Haitz's Law is the equivalent for LEDs and lighting what Moore's Law is for transistors and microprocessors, stating that every decade, the amount of light output by an LED (measured in lumens) increases by a factor of 20, while the price per lumen falls by a factor of ten. In formulating this, Dr. Haitz was the first to grasp the potential for massively reduced energy consumption and correctly predicted the time-scale and degree to which LEDs would triumph over all other lighting technologies in efficiency and cost. Like Moore's Law, his predictions for LEDs were so accurate that they guided the investment and R&D strategies of the solid-state industry, initiating and sustaining an ongoing transformation in lighting that has progressed from his personal vision to global revolution in the last fifteen years.

His zest for the lighting industry didn't wane at all and at 76 he teamed up with fellow luminaries to join a new start-up, QuarkStar, and filed over ten patents in just the last four years alone.

His last remarks on solid-state lighting underlines the progress yet to come: "Solid-state lighting is where the internet was in the 1980's. Just as we could not then have predicted what the internet is now, 30 years later, we cannot foresee all that light and lighting will become in the next decades. We know simply that it will be wondrous and beautiful."

Dr Haitz was an incredible person, father and grandfather and I truly hope history will remember him as a great pioneer of the lighting industry.

INDUSTRY RESTRUCTURING

The biggest news this year has been the continual restructuring of the leading industry players with key announcements from Philips, Osram and GE, all of which will change the landscape forever. The sale of Lumileds to Go Scale Capital from Asia by Philips was continuing apace until it recently hit competition fears in the US. Although the divestment is inevitable, the total spin-off of Philips lighting from group was a less expected announcement. The latest move by Philips confirms the divestment of Lighting is moving at pace, and 2016 will be a year we will see Philips without lighting for a first time in over 100 years.

In April, Osram followed suit and announced it will be spinning off its general lighting business, including general LED lamp based lighting, into an independent company. This was again a major industry decision as in fiscal 2013/14 this business generated worldwide sales of about €2bn (US \$2.15bn) or approximately 30-40% of Osram's turnover and has over 10,000 employees. Reasons given at the time were Osram (like Philips) were trying to

EMERGING CHINESE LIGHTING COMPANIES

No	Company Name	Description	Listed	Revenue (FY14A)	Market Cap (€Bn)	EV/Sales (FY+1)	PE (FY+1)
1	Foshan Electrical and Lighting (Felco)	General Lighting	Yes	423	2.3	2.8	10
2	MLS (Forest Lighting)	General Lighting	Yes	552	2.2	2.7	26
3	Shanghai Felo	General Lighting	Yes	296	1.8	2.8	29
4	Shenzhen Changfang LED	General Lighting/LED Chips	Yes	128	0.8		
5	CNLight	General Lighting	Yes	61	0.8	6.3	77
6	NVC Lighting	General Lighting	Yes	394	0.4		
7	Oppl Lighting	General Lighting	IPO pending	500			
8	TCP International	General Lighting	Yes	445	0.1	0.3	19
9	San'an Optoelectronics	LED Chips	Yes	634	7.9	9.9	29
10	Leyard Opto	LED Chips	Yes	162	2.2	7.7	33
11	Guangzhou Hongli Opto	LED Chips	Yes	141	1.1	4.7	50
12	Ledman Opto	LED Chips	Yes	56	1.1		97
13	Foshan NationStar	LED Chips	Yes	214	0.9		25
14	Shenzhen Jufei Opto	LED Chips	Yes	137	0.8	5.2	30
15	Shenzhen AOTO	LED Chips	Yes	51	0.6	8.6	63
16	Shenzhen Refond Opto	LED Chips	Yes / State	126	0.4		
Average				270	1.5	5.1	41

keep pace with rapidly rising Asian LED lighting manufacturers by spinning off less profitable general lighting businesses. Recent updates from OSRAM indicate the division will be divested by mid-2016 and most probably sold to an Asian company as it will allow an acquirer to gain channel access overseas whilst consolidating a low-cost manufacturing in China.

I totally understand that remaining in the LED lamp industry isn't suited to western companies due to wafer thin profit (and mainly loss) margins, a market in future decline by volume and the need to be a low cost manufacturing economy. However, I also see the impacts of transferring these large scale businesses will have future consequences on the industry we know today. Similar to when IBM sold its PC business to Levano that within a few years dominated the globe and became the world's number one PC manufacturer! The world's third largest lighting company, GE, also decided to restructure its commercial and industrial LED lighting into a new energy services business called Current as part of an overarching Industrial Internet strategy. The GE Lighting brand has all but been wiped out through the rebranding to Consumer and Conventional Lighting segment that will include incandescent and fluorescent lighting as well as residential LEDs. I expect this segment of the business to be divested within the next two years with the likely acquirer being from the Asian region. Other large players such as Acuity Brands (see below) and Zumbobel (acdc) have been making smaller strategic investments based on either technology or project

focused businesses and I see this trend continuing as smaller businesses continue to innovate ahead of the curve and small acquisitions allow the incumbents to keep ahead of the competition.

THE RISE OF ASIAN LIGHTING

The global restructuring of lighting is creating large numbers of billion dollar Asian players, many of which are unknown in Europe or the US but if they were residents would place them in the top ten. A selection of companies have begun to enter Western markets successfully, building brands and market share. For example, San'an Opto (Luminus Devices owner), NVC Lighting and Oppl have successful bases already established in Europe but as can be seen in the above table there are many more lighting companies that are unfamiliar yet to establish themselves.

There is also a raft of new Chinese LED and lighting companies looking to float on overseas markets during 2016, all of which will be looking to put their new found equity to good use!

REMAINING APPLICATIONS FALL TO LEDS

There have been very few lighting application areas that hadn't already succumbed to LED sources. However, 2015 has seen the removal of the last remaining light sources. It's well known that the efficiency of T5 tubes has been tough to beat in offices but with the ferocious price erosion of LED panels, combined with advanced LED controls, the return on investment metric holding back the LED panel onslaught have been slayed forever. In outdoor applications, LEDs also struggled

to match the output of high intensity and high power floodlights. However, this year's Super Bowl took place under 100% LED lighting and, in the past twelve months, manufacturers who had clung to old technologies such as metal halide and cold cathode have now had to embrace LEDs! Consequently, the major manufacturers announced that the majority of their sales were derived not from traditional light sources and fixtures but from LED based systems for the first time. This rapid switch to LED based products vilifies Dr Haitz's forecast that LEDs would reign supreme but fifteen years for a new technology to dominate an incumbent industry is very impressive.

All in all, 2015 has been a solid year of commercial growth but in terms of technology innovation there has been a relative pause as less emphasis is made on increases in efficacy and colour quality improvements. This pause will not happen for long as 2016 and 2017 will lay the foundations for major disruption in lighting that will see companies scramble to become systems providers and develop or acquire controls technology, followed by the gradual shift to data/IT companies. If you don't think this can or will happen then just look at how GE is transforming itself into a software data company. So, if you are not already thinking about how you will deploy advance control systems that monitor how a building is being used, you could become a dinosaur overnight as you will not be able to survive on wafer thin margins that will become commoditised LED fixtures.

ACUITY BRANDS

Acuity has been one of the most aggressive lighting companies in the market by acquiring a raft of businesses to make it one of the most dynamic and interesting companies to watch over the next few years. The acquisitions range from start-ups through to established players and it appears their management are navigating the market disruption well with clear strategic value creation for shareholders. In March 2015, Acuity acquired Distech Controls Inc. from Canada - a leading provider of building automation and energy management solutions that allow for the seamless integration of lighting, HVAC, access control, closed circuit television, and related systems. The reason for the acquisition was Distech provide the digital backbone of intelligent lighting and building systems which are converging to form a platform for the Internet of Things within commercial, industrial and institutional buildings allowing.

In April 2015, start-up ByteLight was acquired, allowing Acuity to offer indoor position location systems using Visual Light Communications (VLC) and have consequently started to offer systems to large retailers such as Target in the US. In October 2015, Acuity announces the acquisition of Juno Lighting a leading provider of downlighting and track lighting fixtures for both residential and commercial applications from Schneider Electric.

ARTISTIC LICENCE

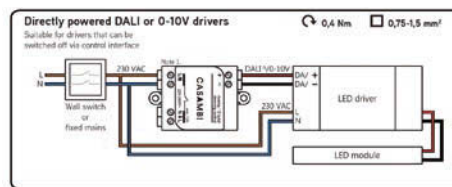
Artistic launched its lightJuice technology that streamlines the way power and data are delivered to IT rich environments through Power over Ethernet (PoE). lightJuice sits at the interface between the PoE supply and the device that is being controlled, such as an LED lamp. A raft of Lightjuice products are set to be launched in 2015 and 2016.

PoE is set to become a major disruptor for the lighting and electrical industry as it eliminates the AC mains wiring that conventionally powers the electrical devices within a building. This equates to significant infrastructure cost savings, particularly as network cabling is a standard feature of modern commercial buildings (and, increasingly, the high-end domestic market). PoE also provides benefits to the end-user through an integrated, connected and reconfigurable solution that use human-safe, low voltage DC (< 60V), so cabling can be moved without the need for an electrician and because the network enables two-way data flow, devices can 'talk' to each other and

relay status information.

CASAMBI

Casambi, a start-up from Finland, launches a wireless light control that can work with any manufacturers' range of existing lights, switches and sensors to enable absolute design flexibility for demanding office, retail, industrial and residential applications. Through the addition of a matchbox sized module installed behind existing light switches or in the luminaire, a system can be setup within minutes. The modules are connected to each other automatically via Bluetooth 4.0 Low Energy (BLE) to form a mesh network and can be configured with the smartphone and via a timer function in the app so illumination can be automatically adapted to the exact time when the sun rises and sets for example.



Example of how Casambi's module is added to a system.

CREE

Cree launched its latest LED technology platform SC5 to power its next generation of high brightness LED. The SC5 provides twice the light output (185 lumens at one watt) of a single LED at temperatures up to 105°C to create a new Extreme High Power class of LEDs such as the XP-L High Intensity LED - the first single-die LED to deliver over 100,000 candela with a 50mm diameter optic at 10W. The XP-L 3.45-mm x 3.45-mm package is characterised and binned at 1050 mA, 85°C, and is available in up to 90 CRI and colour temperatures ranging from 2,700K to 8,300K.

In April, Cree also launched its WaveMax waveguide technology to compete against similar technologies launched by Eaton and GE. The waveguide technology offers 90% optical efficiency whilst providing high uniformity and beam control. Cree haven't really captured significant market share in Europe but this may change in 2016 with the appointment of Nick Farraway as Vice President and General Manager for Cree Lighting EMEA. Nick's move from Sorraa in Europe is a hint that perhaps Cree will push its brand into the LED bulb market, which it has successfully achieved within the USA.

Cree's SC-5 Technology image.

GOOEE

New start-up Gooee launches its wireless RF solution based upon Bluetooth Low Energy (BLE) and announces it has signed deals with seven OEM lighting partners (Architectural FX, Gerard Lighting, Interlight, Havells Sylvania, Mosaic Eins, John Cullen Lighting and Aurora Lighting). Gooee is providing sensing, control and communication components that integrate

with an enterprise scale cloud platform.

IST

IST, a provider of flicker-free LED power solutions, has expanded its strategic offering by launching a range of centralised Power and Ethernet LED driver solutions covering Art-Net, sACN, DALI and DMX across a versatile product range covering constant voltage and constant current solutions. The centralised driver solutions offer significant advantages compared to distributed LED drivers allowing improved system reliability, placement of drivers in easy to reach places for maintenance and allowing fixtures to be up to 300m away. The centralised concepts have been installed at several prestigious sites such as the Vienna International Conference Centre (with over 3,500 Ethernet controlled fixtures), the Dubai Opera House and Sydney Cricket Ground amongst many others.

The IST team are now working on extending the Ethernet concept by delivering a totally secure, resilient and reliable control system for large-scale projects called iMune.

LED ENGIN



Havells-Sylvania's Beacon retail fixture incorporating LuxiTune.

LED Engin announced LuxiTune's colour-tuneable LED product family had integrated ZigBee connectivity. LZ9 LuxiTune enables independent colour and brightness control for compact track light heads, guarantees stable flux and CCT over the entire temperature range. The company also introduced its latest addition to the multi-colour emitter product line with the new 7-colour LZ7 geared for architectural lighting with a fuller spectrum and exceptional colours across a uniform beam angle. Presented with a 7-58° zoom mixing lens, the LZ7 emitter adds amber, cyan and violet to existing RGBW channels to achieve a richer and wider colour combination for more sophisticated mixing.

Enabled by LuxiTune, Havells-Sylvania's Beacon Tune spotlights feature tuneable white light from a bright 4,300K down to a warm 2,100K, while maintaining high colour

rendering index (CRI) with Ra90. They offer exceptionally smooth, flicker-free dimming from 100 to 0.5%

LG INNOTEK

In September, LG announced the launch of high-power LED packages (H35C4 Series) featuring 182 lm/W efficacy, which practically achieves 152lm/W at 85°, 700mA. Through optimising 'white conversion technology', the lifespan of the product has increased greatly to over 150,000 hours.

LG Innotek will further stay focused on developing high performance and value product such as High Power LED Package, featuring more than 5W and UV LED. The company also has a plan to enhance its LED lighting line-up for automotive as well as mobile application.



LG's H35C4 Long-life LED.

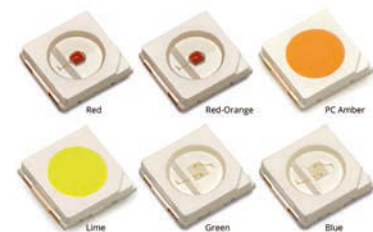
LUMILEDS

Lumileds as an independently run organisation launched a range of new products, such as the high optical power UV flip-chip emitters to the innovative LUXEON 3535L Colour Line, specifically for colour tuneable bulbs and architectural lamps that require access to high quality, single colour mid power LEDs in Red, Red-Orange, Phosphor-Converted (PC) Amber, Lime, Green and Blue.

The PC Amber LED can replace three 2,200K LEDs in a warm dimming lamp, while also delivering best-in-class flux and best-in-class hot/cold factor (flux at 85°C relative to flux at 25°C). The Lime LED features a typical flux of 56 lumens (100mA, 25°C) and a stellar efficacy of 190 lm/W, which when mixed with Red enables a warmer White light to be created compared to Off-White plus Red combinations.

In September, Lumileds launched the high power LUXEON C Colour Line of LEDs to achieve flawless colour mixing by removing the problems of beam halos and mismatched, unmixed colour by designing the platform to offer multiple colours with a single focal length. Performance of the compact LUXEON C 2x2 mm package is achieved through impressive thermal resistance substrates as low as 2.8°C/W.

Lumileds seem to be focusing on the launch of a range of new solutions, including emitters and board-level solutions, and perhaps their independence will allow a renewed focus on what the market wants moving forward. The mid-power colour solutions definitely allow human centric lighting panels to be created with ease!



Lumileds mid-power colour line-up.

LUMINUS

In October, Luminus announced a new high efficacy 3V 3030 Mid-Power LED range, delivering 200 lm/W, 97 CRI and 2,200K Candle-Warm Options. One feature of the Luminus MP-3030-1100 family is 'hot colour targeting', which means that the LEDs are engineered to produce light with chromaticity tightly centred in the ANSI bin under normal operating conditions of 85°C.



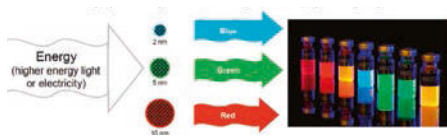
Luminus high efficacy 3030 Mid-Power LED.

NANOCO

In 2015, Nanoco made significant strides with its Cadmium-free quantum dots (CFQD) for LED lighting, announcing a partnership with MARL that enabled the launch of the world's first CFQD LED fixture, Orion QD - a Quantum Dot Linear Lighting solution. In July 2015, Nanoco formed a new lighting division to help accelerate the development of quantum dots for initial lighting applications, including retail and specialty, architecture and agriculture.

The advantage of CFQDs means it is possible to tune the light to exactly the emission spectrum required by controlling the size of the quantum dots. This enables the creation of a light spectrum that isn't possible with standard phosphors, such as the world's first Cool White Healthy lighting Ceiling Tile, having a CRI >95, R9 >90 R9, CCT of 6,500K and a total system efficiency > 100lm/W.

A further advantage of CFQD technology is the ability to reduce the need for strict LED binning, is glare free and provides stable colour quality over time.



Quantum Dots of various sizes convert light to different colours.

OSRAM

Osram launched the Oslon Black SFH 4713A, an infrared LED (IRED) with a wavelength of 850 nanometers (nm) and ideally suited to security lighting applications, such as camera-surveillance of public spaces, company premises and entrances to banks and shopping centres. From autumn 2015, the SFH 4714A with a beam angle of 150° and an optical output of 720 milliwatts enables compact and efficient security lighting.



Osram's high efficacy LED filament engine.

Osram upgraded the Ostar Stage family with a new four 1mm² chip version of the high-power LED in red, green, blue and white, which can be operated at up to 2.5A (DC) to allow an output up to 30W ideal for colour mixed spot lighting.

In October, Osram launched the Soleriq L 38, the first filament LED in its product range. The long thin shape of the LED provides the basis for filament lamps which, in terms of their appearance and emission characteristics, are more than a match for their incandescent lamp predecessors. Each Soleriq L 38 has a length of 30mm and a diameter of 1.8mm, similar to that of a conventional filament, plus an emission angle of 360°, making them perfect for use in LED lamps of all wattages. It is available in three versions with 90, 130 or 140 lm and high luminous efficacy of 150 lm/W to provide warm white light (2,500 to 4,000K) at a CRI >80.

In November, Osram also announced it

will make investments of around €2 billion planned in research and development by 2020 to include:

- Additional €1 billion intended for the construction of a new LED chip plant by 2020;
- 'Diamond' initiative promotes growth and sustained enterprise value;
- Until 2020, average annual growth rates of 8% for revenue and 9% for EBITDA expected.

Key areas of focus include shifting the focus on expanding the electronics and software expertise.

QUARKSTAR

QuarkStar launched a range of lighting modules that are unrivalled in their size and weight, being significantly smaller than any comparable units in the industry - for example, a recessed fixture design can have an aperture of only 2cm, even narrower than the suspended ceiling system support structure. A range of asymmetric luminaires can have optical efficiencies of up to 85+% and a tested efficacy of 85+ lm/W allowing the design of wall wash applications providing illumination ratios of 3:1.



Quarkstar's novel light guide technology.

SEMILED

SemiLED launched its Phosphor Converted, or PC LED chip series including PC Amber, PC Green and PC Red LED chips in a 1mm x 1mm chip size. PC Amber and PC Red on InGaN based materials provide better forward voltage matching in RGBA applications, gaining efficiency and achieving higher lm/W. Greater colour stability is also achieved by the use of PC Amber and PC Red with respect to input currents and changes in junction temperatures. With increased efficiencies, PC Green LEDs offer a broader spectrum and provide a rich, beautiful colour for green coloured applications.

STELLASIA

Stellasia, a three-year old start-up from Japan, has launched a range of LED lighting

systems based upon AC drive technology to offer standard ten-year warranties on its fixtures. Its high specification products include:

- High Bay XI series - based around the m4 hybrid IC (that uses a transformer step down to 30Vac). Companies in Japan that have adopted the High Bay XI AC driven include Honda, Bridgestone, JAXA driven by the high 60C ambient operating environments.
- XW LED tube - based around SOCT (Stella One Chip Technology) which is the first AC drive tube light to meet the strict Japanese 5% flicker standard. SOCT AC direct tube lights are being manufactured by Foxconn (the same company that makes Apple products) and first delivery will be to JAXA and NTT before the end of the year.

VERBATIM

Verbatim introduced an innovative range of dimmable Classic A E27 retrofit LED bulbs that deliver class-leading uniform omnidirectional light, without unsightly shadows or rings, using Mirageball optical technology. To ensure the lighting presents extra warmth and ambience, the Mirageball LED bulbs feature a colour temperature of 2,500K rather than the typical 2,700K of Classic A lamps.



Verbatim's Mirageball lamp.

XICATO

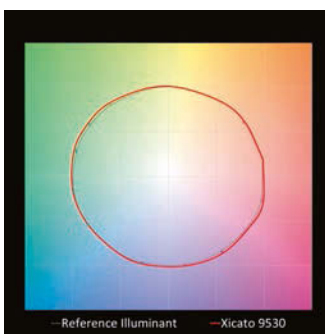
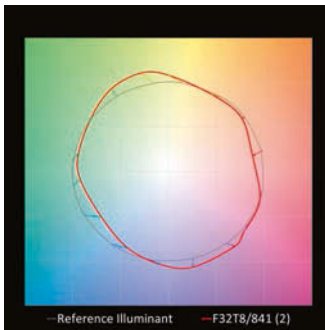
In May, Xicato expanded the Xicato Thin Module (XTM) and Xicato Core Array (XCA) product lines with the availability of new cores with 9mm light emitting surface (LES). The XTM09 can support high quality beam angles of 7.7° using off-the-shelf optics, and can achieve over 44,000 candelas from a 111mm diameter optic.

In September, Xicato committed to the new IES TM-30 benchmark for colour rendering evaluation. Legacy CIE CRI has proven to be a less-than-ideal tool for evaluating colour rendering, especially for LED light sources. TM-30 was developed by the IES to more objectively and thoroughly

evaluate both colour fidelity and gamut for all light sources, and to enable intuitive presentation of the data both quantitatively and graphically.

4100K T8: $R_a=82$, $R_f=77$, $R_g=100$
3000K Xicato Artist Series: $R_a=97$, $R_f=96$,
 $R_g=103$

In October, Xicato dramatically expanded and enhanced its award winning Xicato Intelligent LED Module (XIM) product line from 30 to 100 SKUs, with even greater intelligence and an extended, verifiable, 50,000 hour/7 year, 'B0' warranty on lumen maintenance, colour maintenance, and electronics. XIM is a compact, 48VDC powered LED module capable of instant on/off, and smooth, IEEE 1789-2015 standards compliant dimming from 100% to 1% using 1-10V, or 100% to 0.1% using DALI controls.



Xicato modules now come with TM-30-15 information.

ZUMTOBEL

The Zumtobel Group acquired a majority holding in UK lighting company acdc in September. The company is a supplier of high-end LED lighting solutions with a focus on the architectural façade and hospitality segments.

The key markets for acdc are currently its domestic UK market and the Middle East, along with a selective presence in other European countries and the USA. Huge growth potential exists for the acdc brand, particularly with regard to marketing the acdc product portfolio through the Zumtobel Group's worldwide sales organisation.

WHAT THE INDUSTRY EXPECTS IN 2015...

Torsten Schanze, General Manager, Lighting Business, Nanoco Technologies
"In 2016, Nanoco expects to see a move towards the adoption of intelligent lighting to not only provide new levels of true colour quality, but full energy efficient system control. We expect to see a market pull for high quality light in new market areas due to the recent developments in Nanoco's Cool White technology. We also see enormous opportunity to leverage lighting technology to enhance important markets such as agriculture. In the coming year, Nanoco Lighting plans to continue to drive innovation within the lighting space, enabling users to redefine light and lighting as we know it by bringing colour to life with our intelligent CFQD Quantum Dot film."

Dr Lewis Lerman, Top Quark at QuarkStar Photonics

2016 will see the beginning of the second revolution of solid-state lighting, with the realised need to take greater advantage of the underlying solid-state nature of the LED. To quote the vision of one of our esteemed QuarkStar team members, the late Roland Haitz: "Much like the transition from the transistor to the integrated circuit in computing, the Integrated Circuit of Lighting is the next and final step in SSL design that will allow LEDs to fully realise their potential in general lighting... and so much more."

Menko de Roos, CEO, Xicato

Xicato was the first to commit to reporting TM-30 data on all products, and we expect to see broad acceptance and adoption of this standard in 2016 as the benefits become plain to lighting designers and specifiers.

Wireless technology is rapidly overtaking wired solutions in the creation of networks for lighting control, due to the widespread adoption of Bluetooth, Bluetooth Low Energy (also known as 'Bluetooth Smart' or 'BLE'), and new Wi-Fi wireless technologies. The year 2016 could well see the afternoon of Zigbee and the sunrise of Bluetooth and BLE as lighting control standards, when the Bluetooth SIG releases the open BLE mesh networking codes.

The gradual adoption of wireless networking will make possible another topic of heated discussion in 2015: the Internet of Lighting as part of - and in fact the ideal backbone for - the Internet of Things.

2015 PREDICTIONS - HOW DID GEOFF DO?

• *Ethernet based products will become common place through the use of WI-FI and wired Ethernet driver solution.*

Partially achieved as costs are the most prohibitive drag on adoption. A few leaders that combined Ethernet with centralised power solutions have taken a lead to date.

• *Security of smart lighting systems will become a high agenda item as more systems become compromised by bad actors.*

Not achieved. It seems that despite the near weekly high profile hacking of systems from cars to computers, it hasn't registered with the lighting community as yet!

• *At least two major lighting companies will change hands in the range of > £250m T/O.*

Partly achieved with the acquisition of Juno lighting by Acuity and its other large >£100m T/O controls acquisition.

• *Healthy lighting technologies such as colour tuneable and flicker free LED drivers will become a higher priority for users and specifiers.*

Achieved as many companies have launched Human Centric Lighting solutions to the market.

• *The major lighting companies will sell more LED products than traditional products for the first time.*

Achieved as majority of incumbents sold >50% on a Qtr/Qtr basis.

GEOFF'S PREDICTIONS FOR 2016

• Centralised LED driver solutions will gain further acceptance on prestige installations creating the beginning of Power over Ethernet based products.

• Increased M&A activity will be seen throughout all areas of Lighting

• The reality of the Internet of Things (IoT) wireless hype will begin to be recognised as installations are deployed with integrators preferring copper wire solutions supported by RF where necessary.

• Lighting as a Service will start to accelerate offsetting drastic reductions in Average Selling Prices of LED fixtures. Services based around Li-Fi and indoor location systems will start to be adopted across many sectors.

• LED flicker will become closely monitored in systems due to further health concerns
Have a great Christmas and New Year!

*Geoff Archenhold is an active investor in LED driver and fixture manufacturers and a lighting energy consultant. The views expressed in this article are those of the author and do not necessarily represent the views of mondo*arc.*

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